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THE LABIUM AND SUBMENTUM
IN CERTAIN
MANDIBULATE INSECTS.

BY
CHARLES O. WATERHOUSE, F.E.S.

WITH FOUR COLOURED PLATES.

LONDON:
B. G. RYE, 281 FULHAM ROAD, S.W.

1895.
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[*Price 4s.*]

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MOUTH-ORGANS OF INSECTS.

DURING the last few years various papers and works have appeared which more or less touch on the homologies of the mouth-parts of Insects. In nearly all cases the *submentum* is included in the mouth-organs as part of the *labium*. Most authors state that it represents the united cardines of the second pair of maxillæ, without giving any distinct reason for making the statement; others give reasons which are more or less unsatisfactory; but no one, so far as I am aware, has demonstrated that this view is correct. It is therefore to a great extent with a hope of calling attention to this that I venture to publish some figures of mouth-organs, which I think will be interesting, and which tend to show that all the parts of the maxillæ can be accounted for in the labium without the submentum.

A great deal depends on the part of the labium which bears the palpi—the *palpiger* of Newman*, the *hypoglottis* of Jacquelin du Val†. This part has been much misunderstood or overlooked, although most entomologists, who have paid any attention to the subject, have regarded it as a distinct part between the mentum and ligula. This view I believe to be correct.

* 'Grammar of Entomology,' 1835, p. 113.

† 'Genera des Coléoptères,' 1857, p. lxvi.

THE SUBMENTUM.

The Submentum generally forms a part of the underside of the head, and appears like a continuation of the gula, from which it is seldom distinctly separated—the word submentum being applied to the anterior part, and gula to the posterior part by most authors. In this essay I apply the term submentum principally to the anterior part, the part which in figs. 16, 17, 20, and 22 is anterior to the deep foveæ lettered *x* in the figures *. In the larva of *Corydalis* (fig. 5) it is only indistinctly separated from the rest of the underside of the head, but in the imago (fig. 4) its boundaries are clearly indicated. In *Silpha* (fig. 17) it is somewhat similar in general outline, but is thrust more forward. In *Schizodactylus* (fig. 3) and in other Orthoptera it is of softer texture and less intimately connected with the rest of the head. It is apparently to a great extent due to this fact that it has been included in the mouth-organs as part of the labium, and is regarded, as it seems, by all authors as formed by the united cardines of the second pair of maxillæ. It should be noticed that the maxillæ have their bases situated in the mouth-cavity between the sides of the head and the sides of the submentum, often very loosely hinged with the former, but closely connected with the latter, as I have represented in fig. 1.

In some cases the submentum is reduced to such small dimensions as to be practically absent. In *Silpha* (fig. 17) it is of fair size; in a closely allied genus, *Necrophorus* † (fig. 16), and in *Anthia*

* I do not find any reference to these foveæ in the text-books at hand. They appear to be homologous with the two slits on the underside of the head of *Corydalis*, fig. 4, *x* (compare fig. 4 with fig. 17). In *Corydalis* these are connected by a tube with two openings in front of the antennæ on the upper-side of the head, so that one can see daylight through the head, and a fine wire can be passed freely through. No doubt this curious structure has been noticed, but I have not seen it mentioned.

† In this insect there is a narrow strip of different colour and texture at the anterior border of the submentum; this I take to belong rather to the submentum than to the mentum, but it may be a connecting membrane. It does not affect the present question.

(fig. 20), it is more reduced; in *Mantichora* (fig. 22) it has practically disappeared.

In the above-mentioned insects it must be noticed that the submentum is sometimes hard, as in *Corydalis*, *Silpha*, &c., at other times soft and membranous, at least in part, as in most Orthoptera. I now venture to suggest that the membrane between the cardines of the maxillæ of *Bombus* (fig. 26, *sm*) and other Hymenoptera may represent the submentum, the front part being chitinous and forming the V-shaped piece (figs. 25, 26, *l*), often called "*the lora*," but which, as it is one piece, I propose here to call the *lorum* *. In *Aglæ* (fig. 25, *sm*) this part is almost all chitinous and transversely striolate, and blends gradually in front with the *lorum*. In *Panurgus* (fig. 27) it is chitinous only in front, and appears to be in an intermediate condition, such as I should expect to find, in which the *lorum* is imperfectly formed. If the front margin of this were still more chitinized and a little narrower, it is not difficult to imagine that it might be drawn forwards and occupy the position of the *lorum* on the top of the cardines, as in *Bombus*, *Aglæ* †, &c. Probably a careful examination of genera allied to *Panurgus* would give us the transitional forms from this genus to others in which the *lorum* is completely formed.

THE MENTUM.

The mentum I regard as the united cardines of the second maxillæ. It varies greatly in the Orthoptera, but is always of a more or less soft texture. In the male of *Anostostoma* (fig. 2) it is enormously developed, and is much wider than the submentum. In *Schizodactylus* (fig. 3) it is not so large. In *Cyphocrania* (fig. 6)

* "The lora," according to Kirby, were *two* pieces, each consisting of half the V-shaped piece and what we now regard as the cardo of the maxilla, so that there was a right and left *lorum*. This is evidently what Kirby originally thought; but in a later work he defines the lora as "A machine by means of which the trophi were pushed forth."

† In preparing the specimen from which fig. 25 is taken to show the striation, I have drawn the central piece, *g*, forcibly forward.

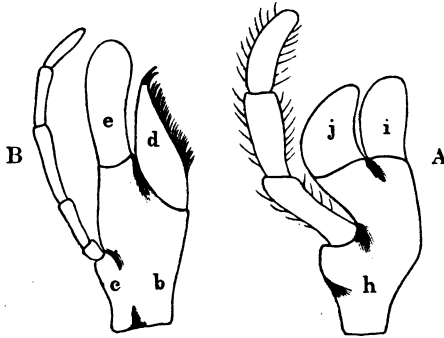
it is merely a narrow strip, but is still distinct. This, however, prepares us to find that in many genera it has practically disappeared, as in *Hierodula*, being apparently only represented by a small triangular area in the middle (fig. 7). In the Coleoptera it is generally considerably developed, varies infinitely in form, but is nearly always of a hard texture. In some cases it closes the whole mouth-cavity and is the only part of the labium visible—*Cryptodus* (fig. 14). In the male of *Ægus punctipennis* (fig. 11) it not only closes the mouth-cavity but is united anteriorly with the epistome, so that the only way in which this insect can take any nourishment is by means of the apical portions of the maxillæ which can be slightly protruded on each side. In this insect, moreover, the suture which divides the mentum from the submentum is absent, except a trace on each side. For comparison I have figured the mentum and submentum of *Ægus platyodon* (fig. 12), in which this suture is well marked.

In the Hymenoptera the mentum is represented by the piece which Kirby called the “fulcrum,” but afterwards correctly, as I think, determined to be the mentum. This view, I find, is supported by M. Jacquelin du Val. It is sometimes hard, as in *Bombus* (fig. 26). It is generally more or less longitudinally channelled, and in some genera has a distinct tendency to divide where it unites with the hypoglottis—*Stizus* (fig. 28, *g*). In *Mygnumia* (fig. 30) it is considerably reduced in size and isolated, and in *Panurgus* is partly membranous; whilst in *Vespa* and other genera it is not represented by any chitinous part.

THE PALPIGER OR HYPOGLOTTIS.

This is the part that bears the labial palpi. It was called the *palpiger* by Newman, the *hypoglottis* by M. Jacquelin du Val; and although I dislike the latter name, I feel constrained to use it to avoid confusion with the *palpifer*, to which it only in part corresponds. It represents the stipes and palpifer of the second pair of maxillæ united, and in my theoretic figure (fig. 1) I have indicated this by dotted lines and by the colours.

In order to understand the component parts of the hypoglottis, a word must first be said as to the palpifer. This is often small, but, so far as my observations go, it is frequently much larger than it appears, as it passes down the side of the stipes or behind it. Its boundaries are often very doubtful, but (without entering into its claims to be considered a distinct part) it is to be observed that it is parallel to the stipes, and not anterior to it.



If we compare half the labium of *Hierodula* (fig. A) with the maxilla (fig. B), in the same insect (omitting the cardo), it seems impossible to mistake the homologies, viz.:— $i=d$, $j=e$, $h=b+c$. If, then, we compare h (the hypoglottis) in figs. 7, 2, & 3, we see most distinctly that the hypoglottis corresponds to $c+b+b+c$ of the two maxillæ. We have now the cardo to account for; and if we had only *Hierodula* to guide us, one might be pardoned for considering the submentum (fig. 7) to represent the united cardines. We know, however, that in a large number of Insects—Hymenoptera, Coleoptera, Orthoptera, and Neuroptera—there is a piece between the hypoglottis and the submentum, viz. the mentum; and I fail to see any reason for doubting that this represents the united cardines.

In many Coleoptera the hypoglottis is very distinct, as in *Silpha* (fig. 17), for example; but, strangely enough, in a very closely allied genus, *Necrophorus*, fig. 16 (a genus with many peculiarities), it is not separated from the mentum by any distinct suture, although it is clearly defined by a difference in colour. By comparing these with such genera as *Dicælus* (fig. 19), *Sphodrus* (fig. 18), and *Anthia*

(fig. 21), one is able to see how it is gradually reduced until the palpi appear to be attached to the mentum. In *Mantichora* it seems to be represented by a small triangular piece at the base of the palpi, only visible from the inner side of the mentum, fig. 24 (upper or inner side). It is, perhaps, best seen as a distinct part in the Passalidæ, *Proculus* (fig. 15), in which it is of hard corneous texture, with the palpi arising as it were from its face.

In the Hymenoptera I consider (as does M. Jacquelin du Val) the hypoglottis to be represented by the piece called by almost all authors the mentum, the central piece which from its tube-like form Kirby called the tubus, fig. 26, *h* (*Bombus*).

We need not expect the division between the palpifer and stipes to be specially marked here ; but I believe the impressed line not uncommonly seen on each side of the median portion may indicate the suture dividing them—*Bombus* (fig. 26) and *Stizus* (fig. 31). In these what I think is the palpifer is seen for its whole length, but in *Vespa* and many other genera it is only visible in front at the base where the two meet (fig. 29) ; the dividing line can, however, be seen the whole length viewing it sideways. A median impressed line is frequently seen and is particularly well marked in *Stizus*.

Above I have said the labial palpi are attached to the hypoglottis. It may be well here to mention that in many cases the basal joint of the palpi is subject to considerable modification, and, as every systematist knows, it is often very difficult to decide the number of joints in the palpi. It is so in the maxillary pair, but to a much greater extent in the labial palpi, so that the basal joint has been by some entomologists treated as distinct, and called the *support of the palpus*, and by others considered to be the homologue of the palpifer. In *Mantichora* (figs. 23, 24) these are very large, free, and upright, with the second joint usually held at an angle. In *Silpha* (fig. 17) the basal joint is large, but can have little movement, appearing to adhere in part to the ligula. In *Lucanus* (fig. 13) the basal joint adheres to the ligula for its entire length. In *Staphylinus* the basal joints almost unite into one, and adhere so closely to the ligula that they appear like part of it. An

examination of a number of species has convinced me that these "supports" are merely imperfectly formed or modified palpal joints; and if I am correct in considering the hypoglottis to be composed of the stipes and palpifer, they cannot be the palpifers, because both the "supports" and the hypoglottis are present in *Silpha*, &c. That they do not belong to the ligula is evident from the fact that in some cases—such as *Anthia*, for example—the ligula may easily be separated without in any way disturbing the attachments of the "supports" of the palpi.

I have called particular attention to these basal joints, and to the way they sometimes adhere to the ligula, because there is something similar at the base of the labial palpi in *Bombus* (fig. 26) and allied forms, so that there appears at first sight to be a small piece between the hypoglottis (mihi) and the ligula, and it has been regarded by Prof. Chatin* as distinct, "la languette." "Le labium est formé comme chez les Insectes Broyeurs. . . . La partie basalaire, le *menton*, répond à la région sous-maxillaire. . . . C'est là que s'insère la *languette*, très réduite et reproduisant la forme propre à divers Carabides." From this quotation it is evident that the author regards this basal part of the ligula as equivalent to the part I call the hypoglottis in the Carabidæ, fig. 19. He has evidently been misled by the way in which the palpi adhere to the ligula at the base. Compare fig. 26 with fig. 13.

THE LIGULA.

Looking at my theoretic figure (fig. 1), it will be seen that the ligula consists of a median portion, *i*, *i** (representing the lacinia), and lateral parts, *j*, *j** (representing the galea). That the lacinia may have a separate terminal lobe is evident from *Hydrous* and *Mantichora* (fig. 22). The ligula, then, in its fullest development consists of two portions—a basal part, next to the hypoglottis, and an anterior part. This is very evident in many cases, as in *Cypho-*

* 'Recherches morphologiques sur les pièces mandibulaires, maxillaires et labiales des Hyménoptères.' Paris, 1887.

crania (fig. 6) and other Orthoptera, as well as in some Hymenoptera. In cases where the ligula consists of one piece, as in *Palpares*, a division seems still traceable, and in *Anthia* (fig. 21), where all the ligula is corneous, the same thing may be noticed. When the anterior part is divided into four lobes, as in *Hierodula*, the basal part frequently has signs of similar division (fig. 7). This seems to indicate that this basal part of the ligula is formed by the union of the basal part of lacinia and the basal part of the galea, as indicated by colour in the figure. This, however, is not a point upon which I should like to lay much stress. In many cases, where there are not sutures, it is impossible to indicate the limits of the parts. The tendency of the paraglossæ to enlarge themselves at the expense of the ligula is shown by comparing *Schizodactylus* (fig. 3), *Agræcia* (fig. 9), and *Acridium* (fig. 10). The boundaries of the other parts in the last two insects are very difficult to determine.

The following are the insects referred to in this essay :—

NEUROPTERA.

SIALIDÆ.

Corydalis.

MYRMELEONIDÆ.

Palpares.

ORTHOPTERA.

MANTIDÆ.

Hierodula.

PHASMIDÆ.

Cyphocrania.

LOCUSTIDÆ.

Anostostoma.

Schizodactylus.

Agræcia.

ACRIDIDÆ.

Acridium.

COLEOPTERA.

CICINDELIDÆ.

Mantichora.

CARABIDÆ.

Anthia.

Dicælus.

Sphodrus.

SILPHIDÆ.

Necrophorus.

Silpha.

HYDROPHILIDÆ.

Hydrous.

LUCANIDÆ.

Lucanus.

Ægus.

PASSALIDÆ.

Proculus.

DYNASTIDÆ.

Cryptodus.

HYMENOPTERA.

POMPIDIDÆ.

Mygnumia.

NYSSONIDÆ.

Stizus.

VESPIDÆ.

Vespa.

APIDÆ.

Panurgus.

Aglaæ.

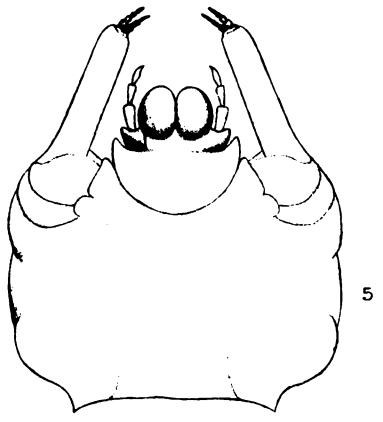
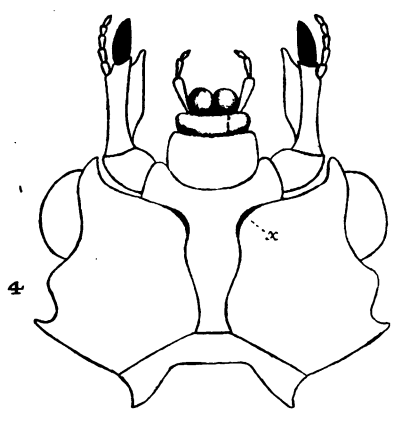
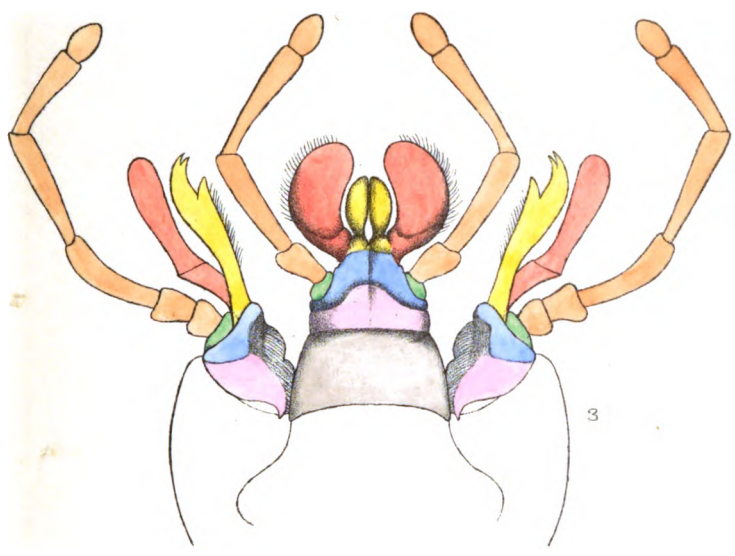
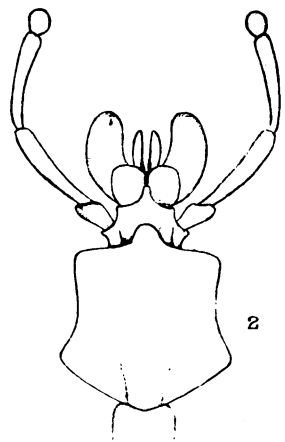
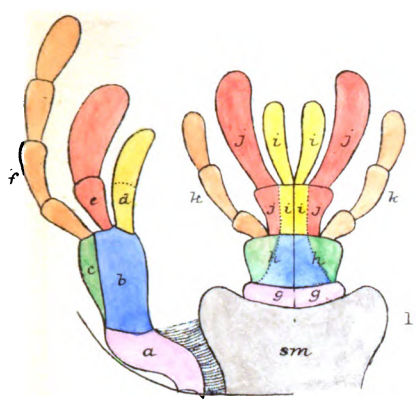
Bombus.

The following are the letters used to denote the parts:—

sm. Submentum.

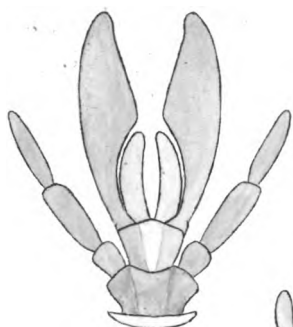
<i>a.</i> Cardo.	<i>g.</i> Mentum.
<i>b.</i> Stipes.	<i>h.</i> Hypoglottis
<i>c.</i> Palpifer.	(or palpiger).
<i>d.</i> Lacinia.	<i>i.</i> Ligula.
<i>e.</i> Galea.	<i>j.</i> Paraglossa.
<i>f.</i> Palpus.	<i>k.</i> Palpus.

The colouring is uniform throughout, so far as the nature of the case will permit. Where the parts are not separated by sutures, the colour merely indicates the supposed region of part.

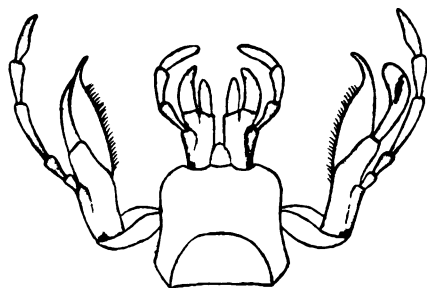


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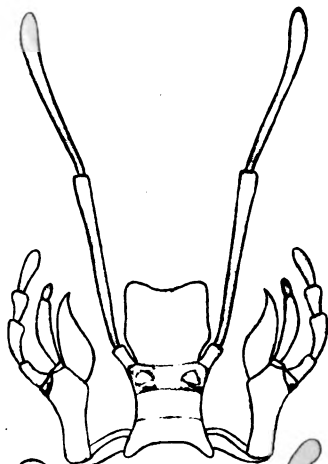
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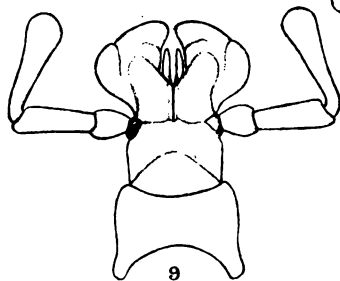
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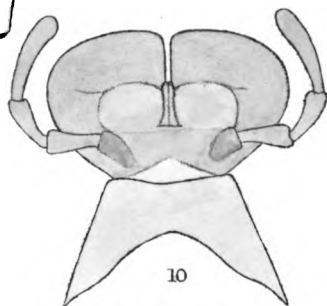
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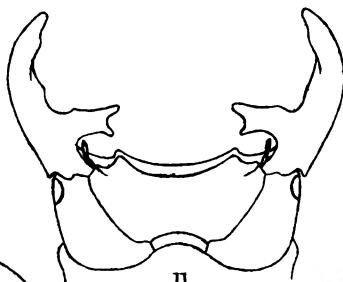
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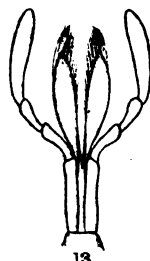
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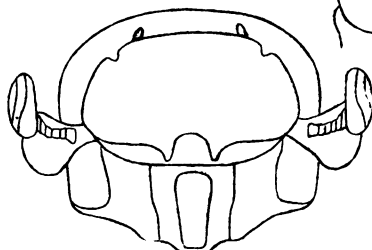
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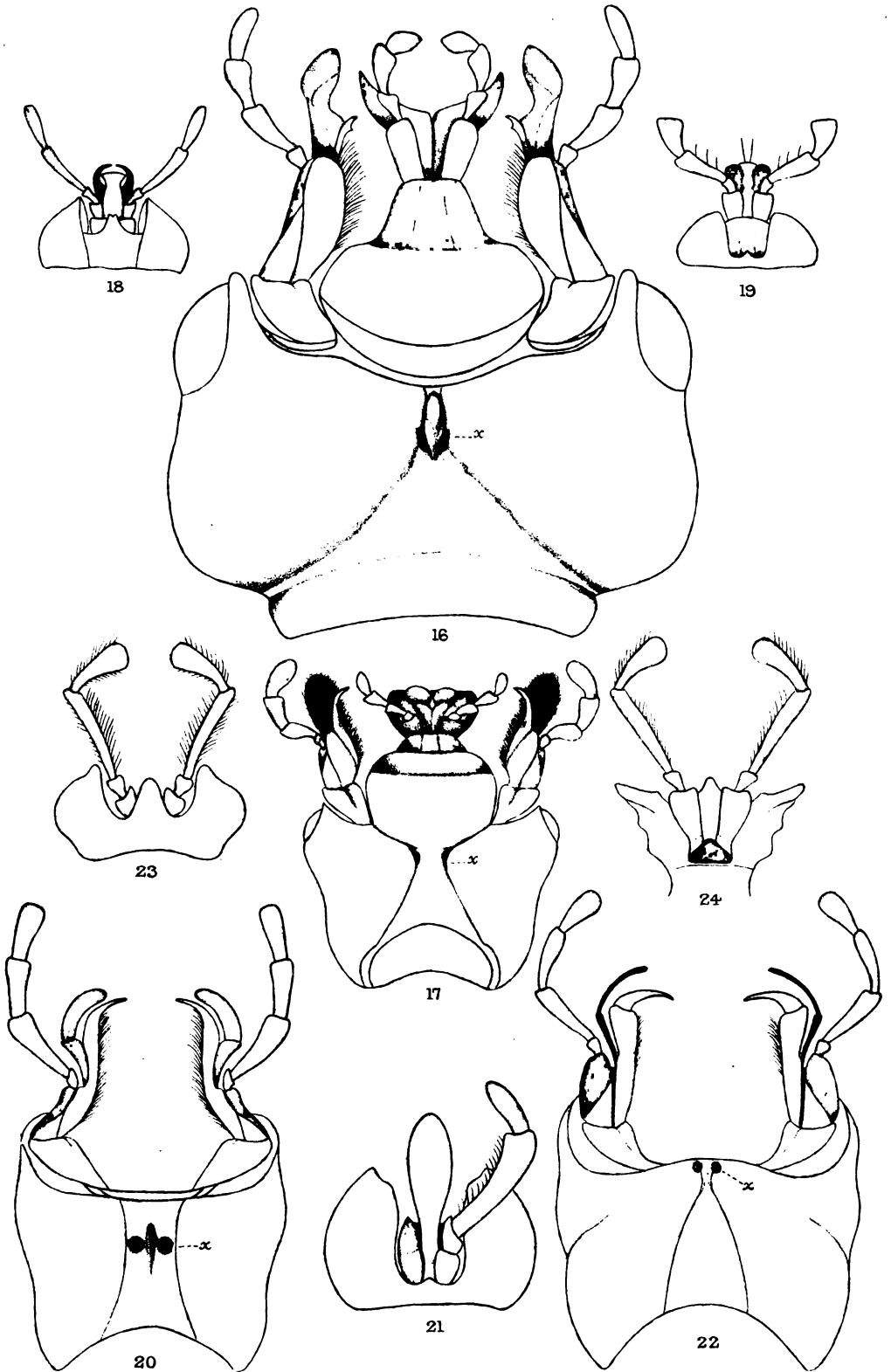
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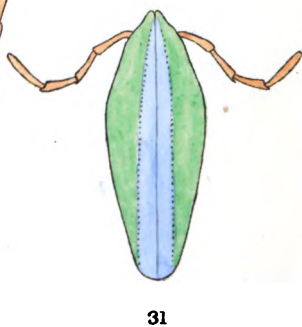
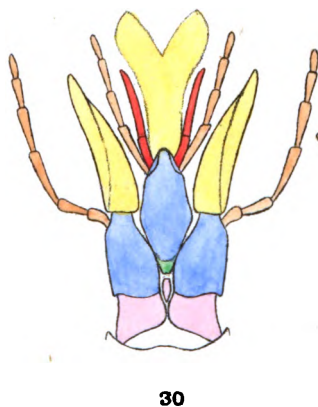
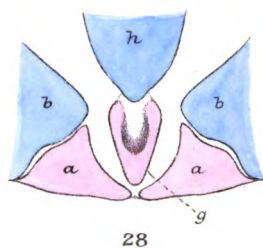
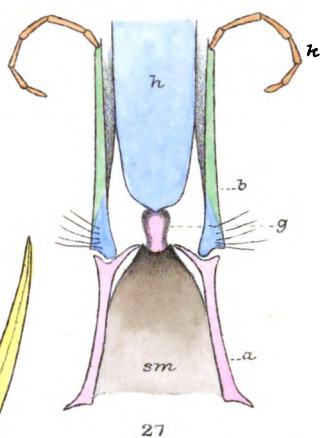
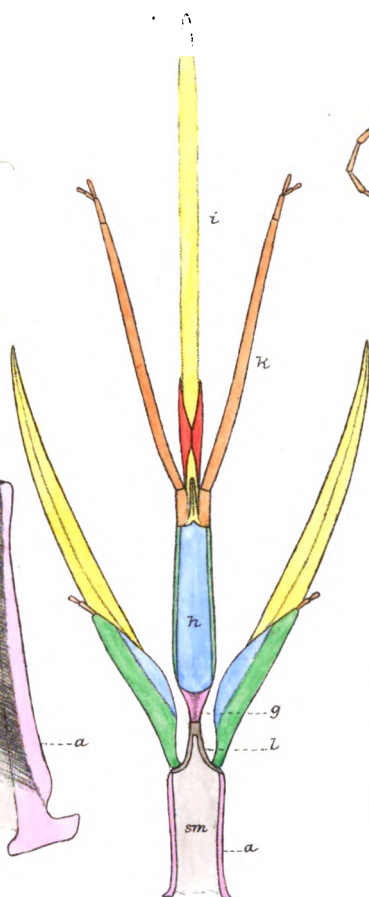
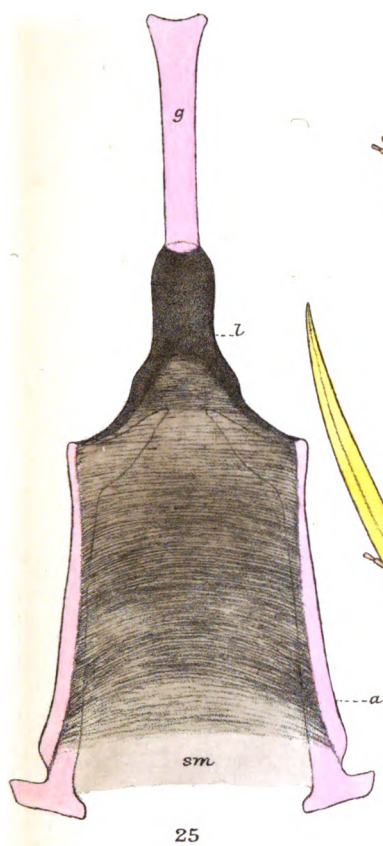


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